(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 489 307 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **91119816.6**

(22) Date of filing: **21.11.91**

(51) Int. Cl.5: **D04B 35/12**, D04B 15/48, B65H 51/30, G05D 13/62

(30) Priority: **04.12.90 IT 2229090**

(43) Date of publication of application: **10.06.92 Bulletin 92/24**

(84) Designated Contracting States: **AT BE DE DK ES FR GB SE**

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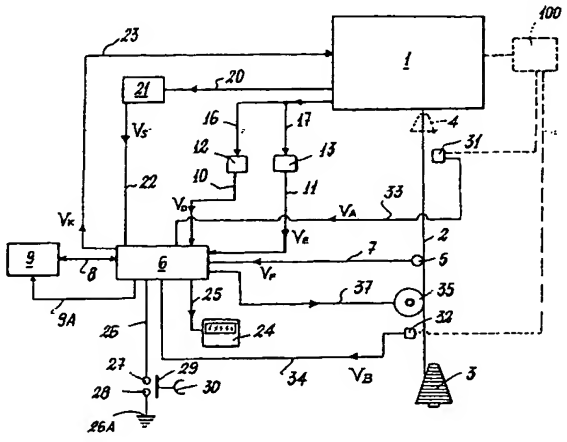
(54) Method and device for automatically controlling the quantity of yarn fed to a textile machine operating discontinuously thereon.

(57) A method for controlling the quantity of at least one yarn fed to a textile machine operating discontinuously on said yarn comprises: a stage, or self-learning stage, in which a master product is produced, the master data relative to the characteristics of the machine during this production and to the quantity of yarn fed to said machine being memorized, and at least one further stage in which a plurality of products similar to the master product are produced, for each of them the current data relative to the machine characteristics (during said production) and to the quantity of yarn fed to it being compared with the corresponding stored master data, members for feeding the yarn to the machine then being controlled on the basis of this comparison such as to maintain said quantity constant during the entire production corresponding to the desired master product. The aforesaid method is implemented by sensor means for determining characteristic data of the machine and data relative to the quantity of yarn fed to this latter during the formation of the products, means for memorizing said data relative to a master product, means for comparing the data obtained during the production of products similar to the master product with the stored data, and means which, on the basis of this comparison, control the operation of the actuator means for the movement of the yarn to the machine, in such a manner as to maintain the quantity of yarn directed to said machine constant during the production.



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This invention relates to a method and device for automatically controlling the quantity of at least one yarn fed to a textile machine operating discontinuously on it.

The invention is particularly directed towards those machines which form discontinuous products each of different colours and designs, such as hosiery machines or circular and straight knitting machines.

Devices are known in the textile field for continuously feeding yarn to a textile machine of the stated type.

The purpose of such devices or feeders is to ensure a constant yarn consumption for all machine feeds, independently of the different yarn tensions created upstream of said devices due, for example, to the natural difference between the yarns of the different yarn bobbins which the machine generally uses during production.

Said feeders are universally known as positive yarn feeders. These devices cannot however be applied to all types of textile machine, and in particular to hosiery machines or to straight jacquard rib knitting machines. This is due to the fact that said machines not only require a continuous change of yarns (used overall to form the product), but also have to operate on yarns of different tension.

The impossibility of applying said devices hence results in a fall in the production yield due to breakages and to the different bobbin tensions, which produce product defects.

In addition, because of the different yarn tensions, it is not possible to produce articles all of the same length, with the result that the production operator has to continuously check the length of the products (and to pair them in the case of stockings), or select the corresponding sizes in the case of knitwork.

In addition to positive devices or feeders, yarn accumulation feeders are known (negative feeders) which, although preventing breakage of the yarn unwinding from the bobbins when used, do not ensure constant yarn feed to the machine.

An object of the present invention is therefore to provide a method for feeding at least one yarn to a textile machine of the aforesaid type such that said feed takes place under constant yarn quantity.

A further object is to provide a method which is simple to implement.

A further object is to provide a device for implementing the aforesaid method which overcomes the drawbacks of known devices.

A particular object of the invention is to provide a device which enables one or two yarns fed to a textile machine of the aforesaid type to be operated in such a manner that the yarn or yarns are fed individually and in constant quantity to said machine for each piece produced.

A further object is to provide a device of low cost, simple construction and reliable operation.

These and further objects which will be apparent to the expert of the art are attained by a method for automatically controlling the quantity of at least one yarn fed to a discontinuously operating textile machine, comprising:

a) a first stage, or self-learning stage, in which a master product is produced, during this production the characteristic machine data and the data relative to the quantity of yarn fed to the machine being determined, said data, or master data, being memorized during this stage;

b) a second stage, or control stage, in which, during the formation of products similar to the master product, the current data corresponding to the previously memorized characteristic machine data and data relative to the quantity of yarn fed to the machine are determined, said current data being compared with the master data, actuator means for the movement of the yarn to the machine then being controlled on the basis of this comparison such as to maintain the quantity fed to the machine constant with time.

The aforesaid method is implemented by a device for automatically controlling the quantity of at least one yarn fed to a textile machine operating discontinuously on said yarn, characterised by comprising first sensor means for determining characteristic data of the textile machine, second sensor means for determining the quantity of yarn directed to said machine, a control unit connected to said said first and second sensor means, and memory means connected to said control unit, this latter being connected to actuator means for the movement of the yarn to said textile machine, to control the operation of said actuator means in such a manner as to maintain the quantity of yarn which they direct to said machine constant.

The present invention will be more apparent from the accompanying drawing, in which the single figure represents a block diagram of a device constructed in accordance with the present invention.

With reference to the said single figure, a textile machine operating discontinuously on one or more yarns (for example a hosiery machine) is indicated overall by 1; it is fed with yarns 2 (only one of which is shown in the figure) which unwind from respective bobbins 3 (only one of which is shown in the figure). Before entering the machine 1, each yarn passes through a corresponding yarn guide 4 shown in dashed lines.

Each yarn 2 cooperates with a sensor 5 arranged to measure the quantity of yarn directed to the machine 1.

The sensor 5 is for example a movement sen-

sor and comprises a roller over which the yarn passes via a known path; in this manner the quantity of yarn which has passed towards the machine 1 is known at each complete rotation of the roller.

The sensor 5 is connected to a control unit 6 to which the sensor feeds its obtained data via a line 7.

The unit 6 is advantageously a microprocessor connected via a line 8 to a random access memory or RAM 9 with which the microprocessor dialogues.

The unit or microprocessor 6 is connected via branches 10 and 11 to a velocity sensor 12 arranged to measure the rotational speed of the transmission shaft (not shown) of the machine 1, and to a sensor 13 arranged to measure the absolute incremental position reached by said shaft during the execution of the production cycle.

Specifically, the velocity sensor 12 is for example a tachometer dynamo connected to the machine 1 via a branch 16, while the sensor 13 is an encoder connected to the machine 1 via a branch 17, said sensors 12 and 13 being suitably coupled to said transmission shaft.

From the machine 1 there also extends a branch 20 terminating in a member 21 of known type (such as a microswitch), connected to the unit 6 via a branch 11. The member 21 is arranged to indicate to said unit the termination (and hence the commencement) of a production cycle of said machine, ie when this latter terminates the production of each stocking.

The machine 1 is also connected directly to said unit 6 via a branch 23.

A display device 24 is connected via a branch 25 to said unit 6, which also receives a branch 26 (connected to earth at 26A) comprising contacts 27 and 28 which cooperate with a movable contactor 29 connected to a pushbutton 30.

Two further sensors 31 and 32 are connected to the unit or microprocessor 6 via respective branches 33 and 34. Said sensors are located between the yarn guide 4 and sensor 5 and, respectively, between the bobbin 3 and an actuator 35 for unwinding the yarn 2 from said bobbin, said sensors 31 and 32 detecting any breakage of said yarn 2 while moving towards the machine 1, or detecting an increase or decrease in the tension of said yarn.

Finally, the actuator 35 is also connected to the unit 6 via a branch 37; this actuator is of known type and can for example be a roller connected to an electric motor advantageously of stepping type, or a small impeller operated by compressed air.

The operation of the device according to the invention will now be described, this description also describing the implementation of the method of the invention.

The operation of the device of the present invention can be divided into two stages:

a) a fist stage known as the acquisition or self-learning stage during which a master product is produced and during which the actuator is deactivated and the relative data of the sensors or encoders 5 and 13 and of the tachometer dynamo 12, based on the absolute incremental position relative to the point of operation of the machine 1 indicated by the sensor or encoder 13, are acquired within a defined time interval determined by consecutive signals originating from the member or microswitch 21 (cycle commencement and termination signals);

b) a second stage known as the control stage, determined by the reproduction, by means of the actuator 35, of the previously acquired speed and working position characteristics stored in the memory or RAM 9.

For this purpose, it is assumed that the master product has been produced free of defects and that the data obtained during the preceding stage are therefore to be considered optimum for the reproduction of the master.

If this is not so, then the self-learning stage is repeated.

During the control stage the device of the invention is able to ensure yarn feed with constant characteristics for all production cycles subsequent to the first acquired cycle, so ensuring that the products are perfectly equal to each other, and of length and quality identical to those determined during the first said stage.

It will be assumed, for example, that the machine 1 is in the end-of-cycle position with the member 21, for example a microswitch (or the like), activated.

In this situation, on operating the pushbutton 30, the unit is set to acquire data.

This unit sets an address line 9A connected to the RAM 9 to an initial position, for example 00, and awaits to receive a signal Vs from the member 21 indicating commencement of the production cycle.

The machine 1 is now operated so that it unwinds the yarns 2 from the bobbin 3 in the natural manner, ie unaccompanied by the respective actuators 35. In this manner the machine 1 produces a first product, defined as the master product.

With the commencement of operation of the machine 1, the member 21 feeds the signal Vs to the unit or microprocessor 6.

On the arrival of said signal Vs, the unit 6 deposits at the "zero" address of the RAM 9 two data items in binary number form, based on the signal generated by the sensor 5 and the tachometer dynamo 12, these data items representing the travelling speed of the yarn 2 with which said

sensor cooperates, and the current machine speed.

Specifically, the sensor 5 generates a signal V_F along the line 7 corresponding to the travel speed of the yarn 2 towards the machine 1 and having a frequency proportional to the speed of the yarn 2, said signal being transformed into a binary number by the unit 6 and stored in the memory 9 via the line 8. If instead the sensor 5 were for example a sensor generating an analog signal (such as a tachometer dynamo), this signal would be converted into digital by an analog-digital converter before entering the unit 6.

With regard to the dynamo 12, this, being directly fixed to the transmission shaft of the machine 1, is able to follow all speed variations of the machine and generate an analog signal V_D proportional to said speed; the signal V_D is suitably converted by an analog-digital converter (not shown) which could form an integral part of the unit 6, and is hence changed into a binary number which represents the sped of the textile machine. This binary signal is then deposited by the unit 6 (which receives the signal) in that location of the RAM 9 adjacent to the binary number representing the yarn speed as indicated by the sensor 5.

On receipt of a first signal V_E generated by the encoder 13, also fixed to the textile machine transmission shaft and giving the position of the machine shaft, the unit 6 to which said encoder is connected increments the address of the next available location of the memory 9 to enable the data obtained by the sensor 5 (yarn speed) and the tachometer dynamo 12 (machine speed), and suitably converted by the unit 6, to be again deposited in it.

It should be noted that the encoder 13, by means of the angular position of the transmission shaft of the machine 1 (or another quantity), senses the formation of each portion of product by the machine. This sensed data item, fed to the unit 6, is then used by this unit as a signal of incrementation of the memory location.

The signals V_F and V_D are therefore stored, for each different product portion obtained, in different cells of the memory 9, with increasing addresses which are incremented at each successive signal V_E reaching the unit 6.

This sequence of operations is repeated until the member 21 generates an end-of-cycle signal which informs the unit 6 that the first acquisition stage has terminated, and that the data contained in the RAM 9 will then represent the comparison data to be followed in order to ensure the same yarn absorption conditions for the control or production cycle stage as for the production of the master product.

As soon as the member 21 generates the end-of-cycle signal (of the acquisition or self-learning cycle) and hence as soon as this member provides a new indication of the commencement of another cycle, the unit or microprocessor 6 reads the data contained in the first location of the RAM 9.

This location contains the two previously described binary numbers generated by the sensor 5 (yarn absorption speed) and by the tachometer dynamo 12 (machine rotation speed).

The sensor 5 and dynamo 12 generate respective signals (V_F and V_D) representative of current data connected with the formation of the product.

These data are continuously addressed to the unit 6 which compares them with corresponding data in the RAM 9. This correspondence is determined by the signals V_R from the encoder 13 which indicate the various angular positions of the transmission shaft of the machine 1, ie which indicate the formation of each further product portion.

If the current data and the previously acquired master data are not exactly equal (in particular the machine speed data from the tachometer dynamo 12), the unit 6 calculates the exact percentage difference between these data to obtain a number which can be used as a correction constant with which to multiply the binary number corresponding to the yarn travel speed contained in the memory 9 location as previously determined by the sensor 5 during the self-learning stage or cycle.

Following this operation, the unit 6 uses the correct binary number corresponding to the exact speed which the actuator 35 must possess for the travel speed of the yarn 2 towards the machine 1 to be maintained constantly equal, or proportional should the tachometer dynamo 12 have sensed a different rotation speed of the machine 1, to that of the initial acquisition or self-learning cycle. The purpose of this is to feed a constantly equal quantity of yarn 2 to the machine for each item produced, independently of any speed variation in the machine.

This comparison between current and master data is continuously repeated for each new pulse received by the microprocessor 6 from the encoder 13, using the data contained in the memory locations subsequent to the initial zero position for the machine operating point which has been reached, as indicated by said encoder.

During this control stage the sensor 5 monitors the yarn speed to check that it is exactly equal to that calculated by the microprocessor 6 and set in the actuator 35 by this latter.

During this control stage the microprocessor 6 is able to supply the operator, via the display 24, with information regarding the instantaneous yarn travel speed towards the machine 1 and the exact quantity of yarn fed to this latter during each control cycle.

It should be noted that by the nature of the

invention, this information will be constantly equal for all control cycles subsequent to the initial acquisition cycle; it will however vary according to the article produced by the machine and acquired during a subsequent operating stage.

The encoder 13 and the tachometer dynamo 12 can be replaced by a single encoder (or similar member), the frequency and number of the generated pulses of which can, by being processed in the unit 6, provide the data relative to the speed of the machine 1 and the absolute incremental position attained by it.

As stated, sensors 13 and 32 are also provided to monitor abnormalities in the yarn 2 during its movement towards the machine 1. The two sensors 31 and 32 can sense both the tension and the breakage of the yarn 2 during its movement towards the machine 1.

In this respect, if a trash build-up on the yarn guide 4 prevents regular yarn movement, a smaller yarn quantity enters the machine. This abnormality is sensed by the sensor 31 which, for example, can be in the form of a usual mobile arm cooperating with the yarn and with a microswitch, able to detect a slowing down in the yarn.

If the machine 1 should require a yarn quantity greater than that fed by the actuator 35, the sensor 31 detects an excessive increase in yarn tension by its mobile arm cooperating with a microswitch.

Again, if the yarn encounters difficulty in unwinding from the bobbin 3, said yarn enters under tension, this abnormality being detected by the sensor 32 by its usual mobile arm cooperating with a microswitch (not shown).

In both cases, whether the yarn tension increases or decreases, the sensors 31 and 32 generate a signal (V_A or V_B) which reaches the microprocessor 6. Following this, this latter generates a halt signal V_K along the line 23 to halt the movement of the machine 1.

Alternatively, the signals V_A and V_B can be fed to a usual unit (indicated in dashed lines by 100) for controlling the machine movement, which halts said machine in known manner on receipt of the signal.

in addition, in all cases, if the breakage of the yarn 2 is instantaneous the sensors 31 or 32 detect this and halt the machine movement (in the described manner).

One device and method according to the invention have been described. This description has been given with reference to a single yarn 2.

It is however apparent that the unit 6 obtains data from several sensors 5 cooperating with all the yarns directed towards the machine 1, and operates on the actuators 35 for these yarns.

Alternatively, a plurality of units 6 can be provided connected to the sensors 5 and to the actuators 35 cooperating with each yarn, the dynamo 12 and the sensor or encoder 13 which generate the signals from the machine 1 then being connected to each of said units 6.

The description is given by way of example only, but modifications can be made to the said device provided they fall within the scope of the present document.

Claims

1. A method for automatically controlling the quantity of yarn fed to a discontinuously operating textile machine, comprising:
   a) a first stage, or self-learning stage, in which a master product is produced, the characteristic machine data and the data relative to the quantity of yarn (2) fed to the machine (1) being determined during this production, said data, or master data, being memorized during this stage;
   b) a second stage, or control stage, in which, during the formation of products similar to the master product, the current data corresponding to the previously memorized characteristic machine data and data relative to the quantity of yarn fed to the machine are determined, said current data being compared with the master data, actuator means (35) for the movement of the yarn (2) to the machine (1) then being controlled on the basis of this comparison such as to maintain the quantity fed to the machine constant with time.

2. A method as claimed in claim 1, characterised in that the self-learning stage is repeated until the master product has been properly formed.

3. A method as claimed in claim 1, characterised in that the characteristic data of the machine (1) are data concerning its usual transmission shaft and relative to the angular position which it reaches during each product portion formed.

4. A method as claimed in claim 1, characterised in that the data relative to the quantity of yarn fed to the machine (1) are data concerning the speed of movement of said yarn during its movement towards the machine.

5. A method as claimed in claim 1, characterised in that the comparison between the master data and the current data comprises calculating the percentage difference between these data and modifying the current data corresponding to the speed of the yarn (2) by a correction factor determined by said percent-

age difference, said modification involving a corresponding modification in the operation of the actuator means (35).

6. A device for implementing the method claimed in claim 1, characterised by comprising first sensor means (12, 13) for determining characteristic data of the textile machine (1), second sensor means (5) for determining the quantity of yarn (2) directed to said machine (1), a control unit (6) connected to said first and second sensor means (12, 13; 5), and memory means (9) connected to said control unit (6), this latter being connected to actuator means (35) for the movement of the yarn (2) to said textile machine (1), to control the operation of said actuator means (35) in such a manner as to maintain the quantity of yarn (2) which each of them directs to said machine (1) constant.

7. A device as claimed in claim 6, characterised in that the first sensor means are at least one member (12), advantageously a tachometer dynamo, arranged to measure the speed of rotation of the transmission shaft of the textile machine (1), and at least one member (13), advantageously an encoder, arranged to determine the angular position of said shaft during said rotation, said angular position being indicative of the quantity of product formed.

8. A device as claimed in claim 6, characterised in that the member for determining the speed of rotation of the shaft and the member for determining its angular position are a single encoder.

9. A device as claimed in claim 6, characterised in that the second sensor means (5) are a sensor able to measure the speed of movement of a respective yarn (2).

10. A device as claimed in claim 8, characterised in that the second sensor means are an encoder (5).

11. A device as claimed in claim 6, characterised in that the control unit (6) is a microprocessor.

12. A device as claimed in claim 10, characterised in that the microprocessor (6) is connected to a display (24).

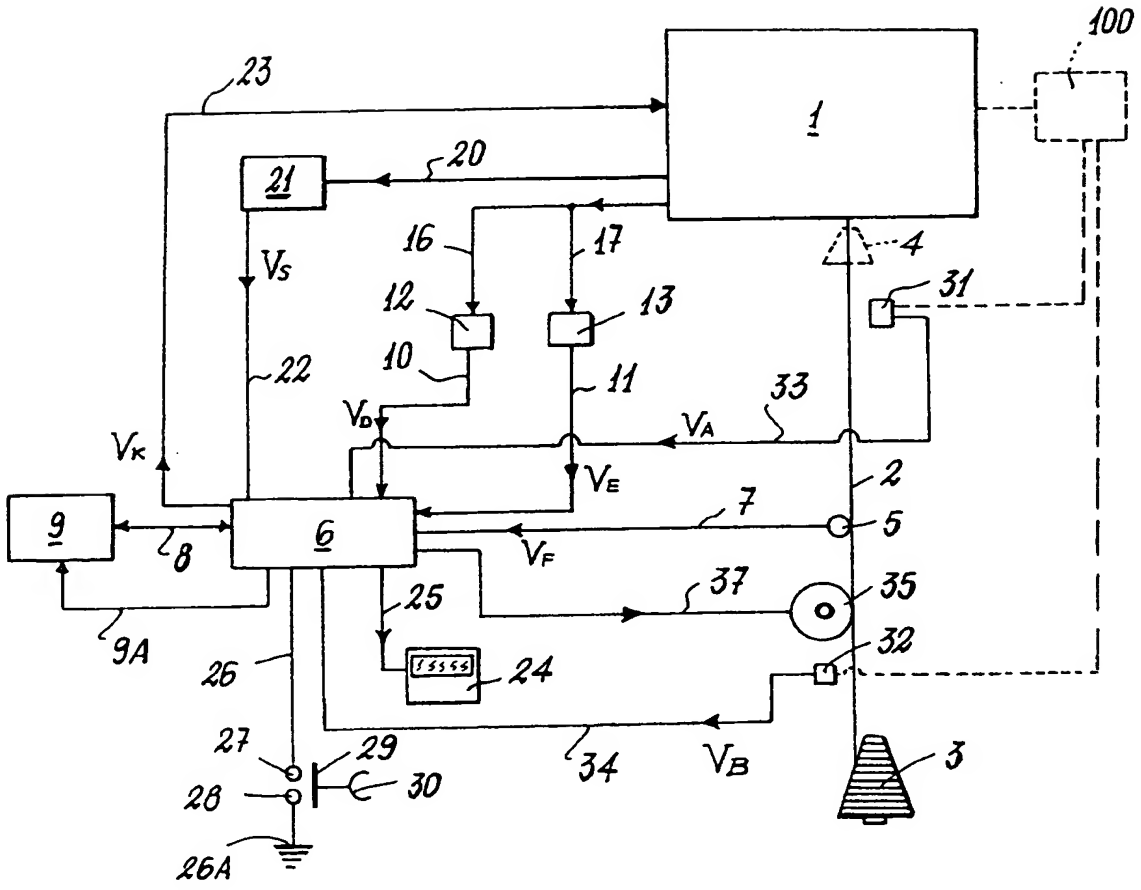
13. A device as claimed in claim 10, characterised in that the microprocessor (6) is connected to a usual member (21) for providing a signal indicating commencement and end of the production cycle undergone by the textile machine (1).

14. A device as claimed in claim 10, characterised in that the microprocessor is connected to a zeroing and setting pushbutton (30) for the acquisition and treatment of the data originating from the first and second sensor means (12, 13; 5).

15. A device as claimed in claim 6, characterised in that the actuator means for the movement of the yarn are a usual electrical or pneumatic actuator (35) for unwinding said yarn (2) from a bobbin (3).

16. A device as claimed in claim 6, characterised by comprising sensor means (31, 32) arranged to determine at least the breakage of the yarn (2) fed to the machine (1) and its tension.

17. A device as claimed in claim 16, characterised in that the sensor means (31, 32) are connected to the control unit (6) which, on the basis of the signals (V_A, V_B) originating from said sensors, halts the operation of the machine (1) when a yarn breakage occurs.



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EUROPEAN SEARCH REPORT

Application Number

EP 91 11 9816

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	DE-A-3 002 311 (H. LUCAS) * page 6, lines 1-12; page 7, line 10 - page 8, line 15; page 9, line 20 - page 11, line 24; claims 1-4; figure 1 *	1-4,6,7,9,11-15	D 04 B 35/12 D 04 B 15/48 B 65 H 51/30 G 05 D 13/62
Y	US-A-4 744 227 (C.G. WHITENER et al.) * abstract; column 2, lines 6-29; column 2, line 60 - column 3, line 2; column 3, lines 13-29; column 3, line 59 - column 4, line 58; column 5, lines 37-57; figures 1-3 *	1-4,6,7,9,11-15	
P,X	EP-A-0 452 800 (BAREA) * abstract; column 3, line 16 - column 7, line 41; figures 1-3; claims 1-5 *	1-4,6,11-14,16	
A	WO-A-8 808 048 (AKTIEBOLAGET IRO) * abstract; page 2, line 31 - page 4, line 16; page 5, lines 5-23; page 6, lines 9-20; page 7, line 5 - page 9, line 21; claims 1-3; figure 1 *	1-3	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	EP-A-0 161 853 (IROPA) * abstract; page 3, line 15 - page 4, line 19; page 5, line 20 - page 6, line 3; page 7, line 13 - page 12, line 3; figures 2-4 *	1,3,4,6,9-15	D 04 B 35/00 D 04 B 15/00
A	EP-A-0 122 582 (AKTIEBOLAGET IRO) * abstract; page 4, line 17 - page 5, line 33; page 10, line 36 - page 12, line 4; figures 1,2 *	1,3,6,7,11,13,16	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	17-03-1992	BEITNER M.J.J.B.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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